

Remarks/Arguments

Amendment to Specification

The specification has been amended at page 6, paragraph [0019] to correct an inadvertent typographical error; "those" has been deleted from line 5 of paragraph [0019]. No new matter has been introduced with the correction.

Amendment to Claims

Claim 1 has been amended to indicate that the vinyl ester of a C₈₋₁₃ neo-acid is obtained from a single or mixture of tri- and tetramers of propylene and to recite the T_g of the vinyl ester of a C₈₋₁₃ neo-acid. Support for the amendment can be found at page 6, paragraph [0019] and page 7, paragraph [0027], of the specification.

Claim 7 has also been amended to recite the typical T_g of the polymer emulsion. Support can be found at page 7, paragraph [0027], of the specification.

Rejection under 35 USC 112

Claims 1-8 were rejected under 35 USC 112, second paragraph, as being indefinite because it was not clear to the Examiner whether the Applicant was claiming a blend coating composition or a substrate having a coating of the claimed blend.

Claim 1 is directed to a blend coating composition comprising a paraffin wax emulsion and a polymer emulsion, wherein the polymer emulsion comprises a polymer containing polymerized units of one or more C₁₋₁₂ esters of acrylic or methacrylic acid and a vinyl ester of a C₈₋₁₃ neo-acid. It has been amended to recite the properties of a dried coating of the blend on a nonwoven or textile substrate. No new matter has been added with the amendment to claim 1. It is believed that the amendment overcomes the rejection of claims 1-8 under 35 USC 112, second paragraph, and the rejection should be withdrawn.

Rejection under 35 USC 103(a)

Claims 1-8 were rejected under 35 USC 103(a) as being obvious over GB 876,226 in view of Swarup et al. (US 6,476,136). It was argued, inter alia, that GB 876,226 teaches a fibrous coating composition comprising a blend of wax emulsion and polymer emulsion. It was also argued that, although GB 875,226 fails to teach the claimed polymer composition, Swarup et al. teach the claimed polymer emulsion composition and also teach that the polymer emulsion composition can be used in coating formulations that are applied to

fabrics. The desire to provide a textile fabric with improved properties such as water and stain resistance was cited as the motivation of a skilled artisan to have combined the references and formed the claimed blend.

Response to 103 rejection

The claimed invention is directed to a blend of a paraffin wax emulsion and a polymer emulsion, in which the polymer emulsion comprises a polymer containing polymerized units of one or more C₁₋₁₂ esters of acrylic or methacrylic acid and a vinyl ester of a C₈₋₁₃ neo-acid. The blend has properties such that a dried coating of the blend on a substrate has a hydrostatic head barrier sufficient to prevent passage of aqueous fluids but allow passage of water vapor through the coating. Hydrostatic head is a measure of resistance to penetration of a fluid under pressure. In this invention, the hydrostatic head is such that fluids will not penetrate the coating; however water vapor is allowed to penetrate the coating. Neither reference cited by the Examiner discusses this phenomenon and do not suggest that the polymers and/or blends disclosed therein would have possessed properties to achieve the hydrostatic head of the blends of this invention.

GB 876,266 discloses a blend of a wax emulsion with a plasticized polyvinyl acetate resin or a plasticized vinyl acetate copolymer emulsion, for use as a coating on fibrous materials to achieve grease resistance and water resistance. A coating of the blend is reported to be block resistant, greaseproof, waterproof, and flexible (page 1, lines 70-73). GB 876,266 does not disclose or suggest that the coating prevents water penetration but allows penetration of water vapor. GB 875,266 does not disclose the polymer emulsion as recited in claims 1-8 of this invention.

Swarup et al. (US 6,476,136 B1) disclose coating compositions derived from polymer latexes containing vinyl neo C₉-C₁₃ carboxylic acid esters and ethylenically unsaturated comonomers such as acrylic acid esters and vinyl acetate. The vinyl neo C₉-C₁₃ carboxylic

acid esters have the structure:

$$R_1R_2R_3C' - \overset{\text{O}}{\underset{\text{H}}{\text{C}}} - \text{O} - \text{C} = \text{CH}_2$$

, wherein R₁, R₂, and R₃ are independently hydrocarbyl groups each having from 1 to 10 carbon atoms, R₁R₂R₃C'- has a neo structure about the C' atom, and R₁ + R₂ + R₃ = from 7 to 11 carbon atoms (claim 1). Exxar Neo 10 and Neo 12 Vinyl Esters are used in the examples of Swarup et al. (col. 5, lines 8-16) and are cited as examples of the vinyl esters disclosed therein (col. 2, lines 36-52). Enclosed with this response is a technical publication entitled, "Exxar Neo Vinyl Esters

for Coatings, Adhesives and Concrete Additives," copyrighted by Exxon Mobil Corp., 2001. The technical publication, at page 1, second bullet point, describes the Neo 10 and Neo 12 Vinyl Esters as resistant to both water absorption and to water vapor transmission (emphasis added). Based on the properties of the Exxar Neo 10 and Neo 12 Vinyl Esters presented in the technical publication, a person of ordinary skill in the art would not have expected that use of a copolymer of one or more acrylates and Neo 10 or Neo 12 Vinyl Esters in a coating composition would prevent water penetration but allow water vapor transmission.

Even if the references were combined as suggested by the examiner, based on the properties of the Neo 10 and Neo 12 vinyl esters disclosed by Swarup, the combination would not have been expected to yield a blend that could be used to coat nonwoven webs or textile fabrics in order to prevent water penetration but allow water vapor transmission.

In a paper presented at an International Waterborne, High-Solids, and Powder Coatings Symposium, 2001 (copy enclosed), copolymers of vinyl Neo 12 esters with methyl methacrylate, butyl acrylate and acrylic acid are reported to have a T_g of 24.1 and 25.4 °C (Table 3, page 69). The polymers disclosed in this publication are similar to the polymers disclosed in Swarup et al. Based on this disclosure, a person of ordinary skill in the art would not have expected the copolymers of Swarup et al. to have the T_g has recited in amended claim 1.

Therefore combining teachings of Swarup et al. with those of GB 876,266 would not have been expected to result in the same type of blend as recited in claims 1-8. The rejection of claims 1-8 under 35 USC 103(a) as being obvious over GB 876,226 in view of Swarup et al. (US 6,476,136) should therefore be withdrawn and all claims should be allowed.

In view of the amendments and arguments made herein, it is believed that the application is in condition for allowance and should be passed to issue.

Respectfully submitted,



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Enclosures:

- 1) Technical Publication: "Exxar Neo Vinyl Esters for Coatings, Adhesives and Concrete Additives." Exxon Mobil Corp., 2001.
- 2) Paper presented at the *International Waterborne, High-Solids, and Powder Coatings Symposium*, 2001, pages 61-76.

c: R. A. Borst/File



NEO VINYL ESTER LATEXES FOR WOOD, METAL AND CONCRETE COATING APPLICATIONS

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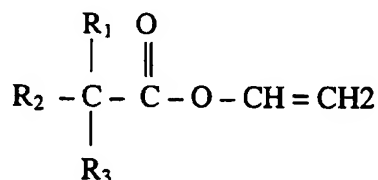
ABSTRACT

Neo vinyl esters (VE) can be copolymerized with vinyl acetate (VA) and acrylic monomers in various combinations to provide improved coating performance. The improved performance is primarily due to the steric structure and hydrophobic character of the VE monomers. For interior coatings, VE/VA copolymers provide excellent scrub, water and stain resistance. Exterior coatings over concrete, wood, and metal substrates based on VE/VA or VE/Acrylic copolymers offer excellent weathering, water and corrosion resistance.

Introduction

Emulsion polymers have been widely used in coating and adhesive applications due to their ease of production, processing, and environmental benefits. The North American emulsion industry produces a wide variety of emulsion polymers including vinyl-acrylic (vinyl acetate and butyl acrylate copolymer), styrene-acrylic (styrene, butyl acrylate, and methyl methacrylate copolymer), VAE (vinyl acetate and ethylene copolymer), and all-acrylic (methyl methacrylate and butyl acrylate copolymer). These copolymers offer a wide range of cost and performance choice. The emulsion industry as a whole, however, is constantly facing the challenge to introduce products which can deliver the required performance at a lower cost. Recently, emulsion polymers containing branched neo vinyl esters have gained attention in North America due to their ability to address both cost and performance issues. Neo vinyl ester based emulsion copolymers provide excellent water resistance and alkaline stability. These copolymers exhibit superior performance for architectural interior and exterior coatings as well as metal coatings.

The branched neo vinyl esters are derivatives of neo acids (α, α, α -trisubstituted acetic acid). They are schematically represented as



Where R_1 , R_2 , and R_3 are alkyl groups. Several neo vinyl esters are commercially available with $\text{R}_1 + \text{R}_2 + \text{R}_3$ averages of 8 and 10 carbons, respectively, under the ExxonMobil Chemical trade name Exxar® Neo Vinyl Esters.

It has been demonstrated¹⁻³ that branched neo vinyl esters will react randomly with vinyl acetate and provide shielding for the acetate groups from hydrolysis and alkali attack. Therefore, polymer films containing neo vinyl esters have superior resistance toward alkaline hydrolysis and water resistance. The bulky side chains also lower the moduli of the copolymers and result in better bonding to both pigment and substrate.

The present investigation is aimed at studying the effect of branched neo vinyl esters on the performance of emulsion polymers in architectural and metal coatings. A viscoelastic model is also proposed to correlate the polymer structure to coating performance.

Experimental

Latex Synthesis. A typical emulsion polymerization technique is used to synthesize the latex at 65°C reaction temperature using a colloid stabilized recipe. The detailed procedure was described in a previous paper⁴. The final latex has the total solids around 53 wt.% and particle size around 250-350 nm. The latexes, without neutralization, were used directly for paint formulation.

Latex Characterization. Particle size of the latexes was measured using a Coulter N4MD sub-micron particle size analyzer. Minimum Film Forming Temperature (MFT) was determined using the Paul Gardner MFT Bar 90.

Alkali Hydrolysis Test. Tests were carried out on wet latexes by addition of 50 mL of 1N NaOH to 5 g of latex, and then titrating 5mL of the mixture against standard HCl to determine the alkali consumed after 4, 24, 48, and 72 hours. The results are reported as % NaOH consumed by the latex.

Water Uptake Measurements. To a sample of latex, 10 phr Texanol[®] based on % solids of the latex was added. The latex was shaken well on a vortex shaker, and 4 mil wet film thickness were prepared using a draw down bar on polypropylene panels. The films were dried at room temperature for a week. The dried films were cut to about 7 cm x 1.5 cm specimens, weighed and soaked in 20 mL deionized water for 7 days. The films were then removed from water, patted dry with a lint free filter paper and weighted. The weight of water absorbed is reported as percentage weight gain.

Scrub Resistance. Scrub resistance was tested according to ASTM D2486.

Stain Resistance. Stain resistance was tested according to ASTM D3258 (K & N).

Water Vapor Transmission. Water vapor transmission was tested according to ASTM D1653 (dry cup method).

Corrosion Resistance. Corrosion resistance was evaluated according to ASTM B117-90. The degree of rusting and the creepage at the scribe area were rated according to ASTM D610-85 and ASTM D1645-92, respectively.

Results and Discussion

Hydrophobicity. This property was tested by the water uptake of the latex clear films and the water vapor transmission of derived paints. The effect of Neo 12 monomer on the film water uptake was demonstrated using a series of four VA/BA/Neo 12 latex samples with Neo 12 content varied from zero to 30 wt.%. Figure 1 displays a significant reduction of water uptake as the Neo 12 level increases. A separate series of VA/BA/Neo

12 latex samples containing from 0 to 45 wt.% Neo 12 was used to formulate interior flat paints at 35% PVC level. These paints were used to study the rate of water vapor transmission based on ASTM D1653 method. The results, as displayed in figure 2, indicate that Neo 12 can significantly reduce the rate of water vapor transmission for formulated coatings. All the latex samples used in this study contains VA/BA monomer feed at 70/30 ratio in order to maintain the design Tg at 0°C according to Fox's equation. The interior flat paint formulation is summarized in the attached Table 1.

Resistance to Alkaline Hydrolysis. It has been demonstrated¹⁻³ that due to their similar reactivities, vinyl acetate and neo vinyl ester form a random copolymer. Conversely, due to the very different reactivity between vinyl acetate and butyl acrylate, the copolymer of VA/BA will exhibit a somewhat blocked structure rather than random. Since vinyl acetate hydrolyzes easily in an alkaline environment, we can expect a rather poor hydrolysis resistance for VA/BA copolymer. In the case of VA/Neo 12 copolymer, the long side chains of the Neo 12 monomer will provide shielding for VA against water and alkaline molecules. Figure 3 demonstrates the effect of Neo 12 on alkaline hydrolysis. VA/BA copolymer at an 80/20 monomer feed ratio results in 46% hydrolysis. VA/Neo 12 copolymer at an 85/15 monomer ratio has much lower degree of hydrolysis at 26% even though the VA content is higher than the previous VA/BA copolymer. For VA/Neo 12 at a 70/30 ratio, the degree of hydrolysis is very low and at the level close to typical all-acrylic products.

Blends of economic VA/BA with all-acrylic latex are also commonly used by architectural coating formulators to optimize cost and performance. To evaluate the performance of latex blends under alkaline environments, a commercial vinyl-acrylic(VA/BA) and a VA/Neo 12 (85/15) latex were blended separately with a commercial all-acrylic resin, in various blending ratios. The results of alkaline hydrolysis are shown in Figure 4. The figure shows the VA/Neo 12 system outperforms commercial vinyl-acrylic at the same blending ratio. The VA/Neo 12 system delivers the same performance as the vinyl acrylic system but with a much lower all-acrylic content. This can be translated into significant cost savings for formulators without sacrifice of performance.

Interior and Exterior Architectural Coatings. The actual outdoor (at 45° south-facing) fence test over concrete surface confirms the performance advantage of VA/Neo 12 over vinyl acrylic. Figure 5 reveals the results of a 16-month fence test study for 45% PVC exterior flat paints over an uncured blockaid surface. Based on the formulation given in Table 2, these paints were formulated from latex blends of either VA/BA or VA/Neo 12 with a commercial all-acrylic resin. The test results indicate VA/Neo 12 blends containing 25% all-acrylic resin outperforms VA/BA blends containing 75% all-acrylic resin. A significant cost savings can be realized by substitution of VA/BA with VA/Neo 12 copolymers.

A VA/Neo 12 copolymer alone can also be used for interior flat formulation. Figures 6 and 7 compare the scrub and stain resistance of interior flat paints formulated with

VA/Neo 12 and VA/BA latexes. Over a wide PVC range, VA/Neo 12 demonstrates better scrub and stain resistance than VA/BA copolymer.

Terpolymers of VA/BA/Neo 12 have demonstrated excellent performance in exterior coatings over a wide range of substrates. Figure 8 reveals a 30-month 45° south-facing fence test over southern yellow pine, Hardie Plank, and blockaid substrates. This study was based on 45% PVC exterior flat formulations using a commercial all-acrylic product and VA/BA/Neo 12 terpolymers with Neo 12 content ranging from 10 to 30%. The test result indicates VA/BA/Neo 12 latex at 49/21/30 ratio can deliver the same overall performance as the commercial all-acrylic product. The VA/BA/Neo 12 terpolymer is significantly more economic than BA/MMA all-acrylic product and offers the formulator significant cost savings opportunity without sacrifice of performance.

Metal Coatings. In order to investigate the effect of Neo 12 on metal coatings, three latex samples were synthesized according to the compositions listed in Table 3.

The paint formulation used for the metal coating study is listed in the attached Table 4. The formulated paints at 20% PVC were coated over cold roll steel panels and let dried for a week. The surface gloss measured at 85°, 60° and 20° are summarized in figure 9. It is clear that Neo 12 improves the gloss and the effect is especially pronounced for the low angle measurement. Figure 10 displays the rate of water vapor transmission for the same 20% PVC paints tested according to ASTM D1653 method. The results indicate a significant reduction in the transmission rate. The sample containing 60% Neo 12 actually has lower transmission rates than commercial styrene-acrylic samples. Lower water vapor transmission is key to corrosion resistance, a very important performance attribute.

Corrosion resistance was evaluated using the salt fog test according to ASTM B117-90. Q panels without further cleaning were coated with the tested formulations and placed in a salt fog chamber. Figure 11 displays the Q panels after 500 hours in chamber. It is demonstrated Neo 12 significantly improves the corrosion resistance. The degree of rusting was rated according to the method described in ASTM D610-85. It is scaled into 11 grades from 0 (100% of surface rusted) to 10 (no rusting). The scribed area provides a means of evaluating corrosion and loss of adhesion at a scribed mark. The creepage at the scribe area was rated from 10 (zero creepage) to 0 (over 16 mm creepage) according to method described in ASTM D1645-92. The results of performance rating are summarized in figure 12. The test results suggest that acrylic compositions containing 30 to 60% Neo 12 can provide better corrosion resistance than commercial styrene-acrylic products used in the experiment.

Theoretical Consideration

Waterborne polymers are widely used in paint formulations as binders for pigments. In addition, these polymers also provide bonding to coating substrates. The best binder is therefore the one that can establish and then maintain a strong bonding to both pigments

and substrates under the application environment. Most of the coating applications deal with physical bonding that is driven by the thermodynamic work of adhesion. However, it is also equally important to consider the kinetic aspect of the bonding that is closely related to the viscoelastic flow properties of the polymer.

We can regard the physical bonding as establishing a contact between two separate objects. Considering the contact between two spheres with radius R_1 and R_2 under pressure P , Hertz⁵ related the contact to Young's moduli, E_1 and E_2 of the two spheres through the following equations

$$a^3 = \frac{3\pi}{4} P (k_1 + k_2) \left(\frac{R_1 R_2}{R_1 + R_2} \right) \quad (1)$$

$$k_1 = \frac{1 - \nu_1^2}{\pi E_1}, \quad k_2 = \frac{1 - \nu_2^2}{\pi E_2} \quad (2)$$

Where a is the radius of the contact area and ν is the Poisson's ratio. This equation was modified by Johnson, Kendall, and Roberts⁶ to include the work of adhesion W

$$a^3 = \left(\frac{R}{k} \right) \left\{ P + 3\pi WR + \left[6\pi WRP + (3\pi WR)^2 \right]^{0.5} \right\} \quad (3)$$

$$\frac{1}{k} = \frac{3\pi}{4} (k_1 + k_2), \quad R = \frac{R_1 R_2}{R_1 + R_2} \quad (4)$$

For waterborne polymers used as a pigment binder, The modulus, E_1 , will be significantly lower than the modulus of the solid pigment, E_2 . The radius of the polymer particle, R_1 , is also much smaller than the radius of the pigment particles, R_2 . The equation above therefore can be simplified as

$$a^3 = \frac{3}{4} (1 - \nu_1^2) \cdot \frac{R_1}{E_1} \cdot \left\{ P + 3\pi WR_1 + \left[6\pi WR_1 P + (3\pi WR_1)^2 \right]^{0.5} \right\} \quad (5)$$

The bonding between pigments and polymer particles is therefore strongly affected by the polymer particle size, polymer modulus, pressure, and thermodynamic work of adhesion. The pressure P is derived from the capillary force as water vaporized from the paint formulation. The most significant inherent property that affects the bonding is the modulus of the polymer at the bonding temperature. It has been well recognized that

modulus is related to the bulkiness of the polymer side chain. Copolymers containing neo vinyl ester monomers will have lower modulus due to the side chain bulkiness. This is demonstrated in figure 13 where moduli of VA/BA/Neo 12 terpolymers decrease as Neo 12 content increases. As the modulus of the polymer decreases, the polymer particles will coalesce to a greater degree and result in higher gloss films. The bonding between polymer, pigments, and the substrate surface will also become more efficient and strong, resulting in a higher scrub, stain, and corrosion resistance. These are demonstrated in figures 6, 7, 9, 11, 14 and 15.

Conclusions

It has been demonstrated that branched neo vinyl esters can easily copolymerize with a wide variety of monomers including vinyl acetate(VA), butyl acrylate(BA), methyl methacrylate(MMA) and acrylic acid(AA).

VA/Neo 12 copolymers can be used for both interior and, as a blending component with all-acrylic latex, exterior coating applications. For interior flat coating, VA/Neo 12 exhibits better performance than commercial vinyl-acrylic. For exterior coatings, the same copolymer replacing vinyl-acrylic in the vinyl-acrylic/all-acrylic blends achieves the same performance at a lower all-acrylic content. In an extended outdoor fence test, VA/BA/Neo 12 terpolymer achieves the same performance as a leading commercial all-acrylic product over both wood and concrete substrates. Neo 12 can also be used to modify all-acrylic composition for metal coating applications. It has been demonstrated that MMA/BA/AA/Neo 12 copolymers exhibit better corrosion resistance than those commercial styrene-acrylic products used in the present study.

A modified JKR model is proposed to explain that neo vinyl esters improve the binding capability to pigments and substrates through lowering the moduli of resulting copolymers. Because of the long branched side chains, neo vinyl esters also improve the water resistance and provide shielding for VA against alkaline hydrolysis. The combination of these technical attributes make neo vinyl esters economically ideal candidates for both interior and exterior coatings over wood, concrete, and metal substrates.

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2. G. A. Vandezande, O. W. Smith, and D. R. Bassett, in *Emulsion Polymerization and Emulsion Polymers*, El-Aasser and Lovell (eds.), Wiley, NY, Ch. 16, (1997).
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5. H. Hertz, J. Math, Vol. 92 (1881)
6. K. L. Johnson, K. Kendall, A. D. Roberts, *Proc. R. Soc. Lond. A.* 324, 301 (1971)

Table 1. Interior Flat Wall Paint Formulation

Ingredients	Weight, g
Water	22.57
Cellosize® BR-30m	0.25
Mix 10 minutes, then add:	
Nuosept® 95	0.17
Tamol™ 731A	0.48
KTTP	0.07
Tergitol™ NP-9	0.14
Propylene Glycol	1.49
Rhodoline® 643	0.14
Mix for 5 minutes, then add:	
Tipure® R-931	22.53
Optiwhite®	7.52
#1 White™	5.54
Celite® 281	3.25
Ammonia (28% aqueous)	0.11
Grind to 3.5+ Hegman	
Latex (52.11% solids)	25.91
Texanol®	1.35
Rhodoline® 643	0.14
Water	8.34
Total	100.00

Note: Above table is based on 50% PVC formulation

Table 2. Exterior Flat House Paint Formulation

Ingredients	Weight, g
2.5% Cellosize® QP4400 solution	10.73
Water	8.59
Mix, then add:	
Ethylene glycol	5.58
Rhodoline® 226-35	0.87
KTPP	0.13
Triton® CF 10	0.22
Rhodoline® 643	0.09
AMP-95®	0.09
Mix for 5 minutes, then add:	
Tipure® R 902	19.62
Eagle Zinc 471W®	2.18
Minex™ 4	12.64
Optiwhite®	4.36
Attagel® 50	0.44
Grind to 6+ Hegman	
Latex (53.5% solids)	32.46
Texanol®	1.63
Skane® M 8	0.08
Rhodoline® 643	0.12
Ammonia (aqueous)	0.17
Total	100.00

Note: Above table is based on 45% PVC formulation

Table 3. List of Latex Samples for Metal Coating Study

Latexes	Neo 12 (%)	MMA (%)	BA (%)	AA (%)	Tg by DSC (°C)
Composition 1	0	59	40	1	24.2
Composition 2	30	46	23	1	24.1
Composition 3	60	32	7	1	25.4
Commercial Styrene-Acrylic (A)	NA	NA	NA	NA	33.9
Commercial Styrene-Acrylic (B)	NA	NA	NA	NA	32.4

NA: not applicable

Table 4. Formulation of High Gloss White for Metal Coating

Ingredients	Weight, g
Water	5.33
Surfynol® 210	0.02
Natrosol® 250 HBR	0.03
Mix 5-10 min.	
Ammonia (28%)	0.01
Mix 10-15 min.	
Surfynol® 104 DPM	0.48
BYK® 155	0.21
Ti Pure® R-1076	21.33
Disperse to 7 Hegman gauge	
Latex	63.02
Surfynol® 210	0.48
Surfynol® 104 DPM	1.45
Ammonia (28%)	0.19
Eastman™ EB	2.9
Eastman™ DP	0.72
Sodium nitrite (10%)	0.61
Premix then add	
Water	2.98
Acrysol™ RM-8-W	0.24
Total	100.00

Note: Above table is based on 20% PVC formulation

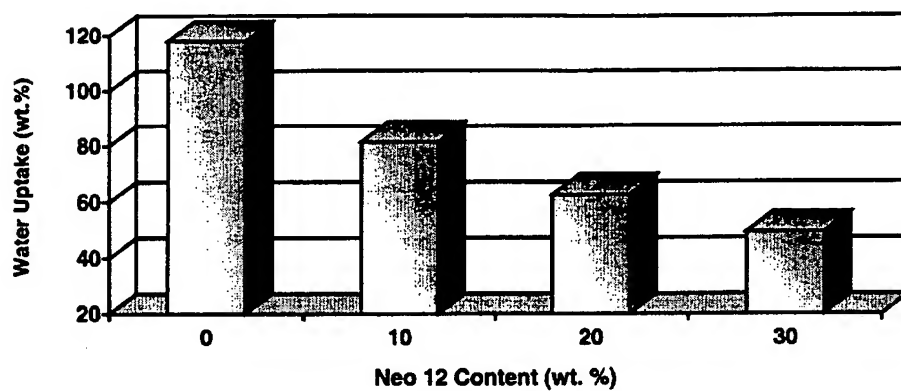


Figure 1 Water uptake of VA/BA/Neo 12 terpolymers

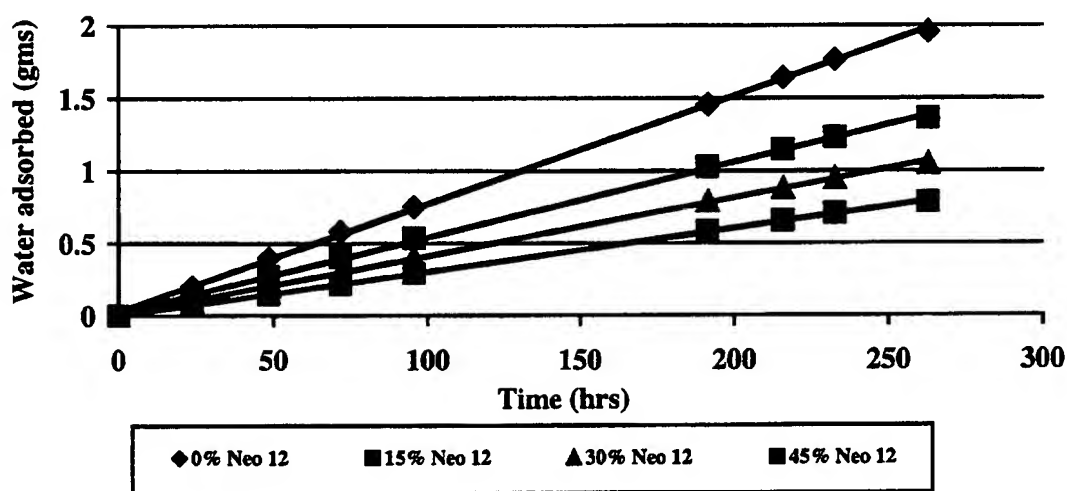


Figure 2 Water vapor transmission of paints formulated with VA/BA/Neo 12 terpolymers

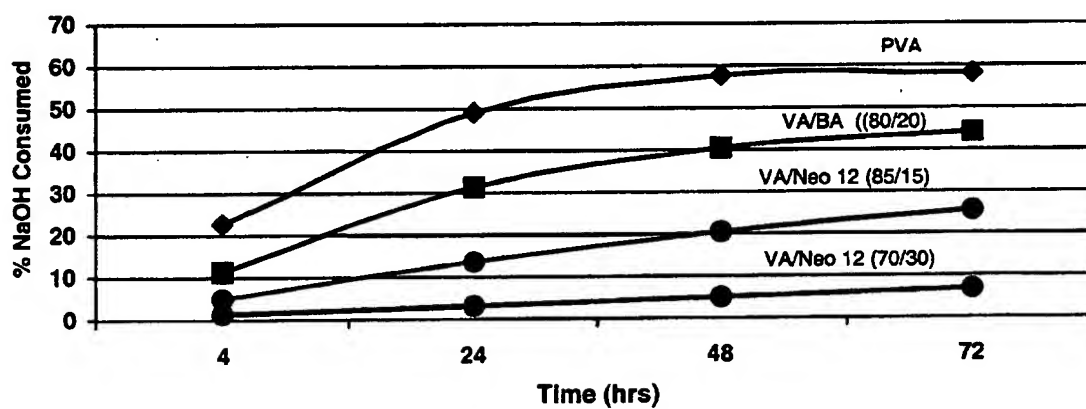


Figure 3 Alkaline hydrolysis of PVA and VA copolymers

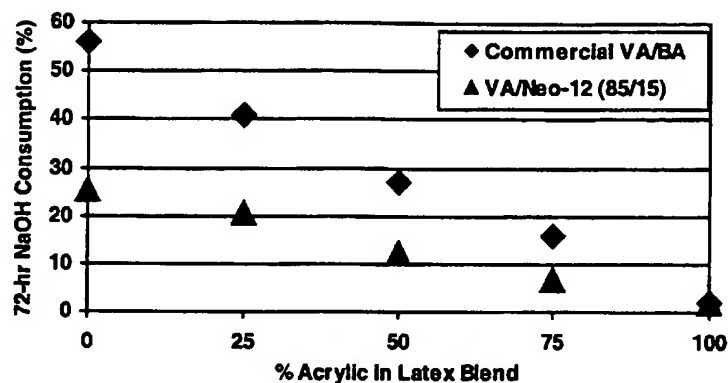


Figure 4 Effect on alkaline hydrolysis of blending 100% acrylic with VA/Neo 12 or VA/BA

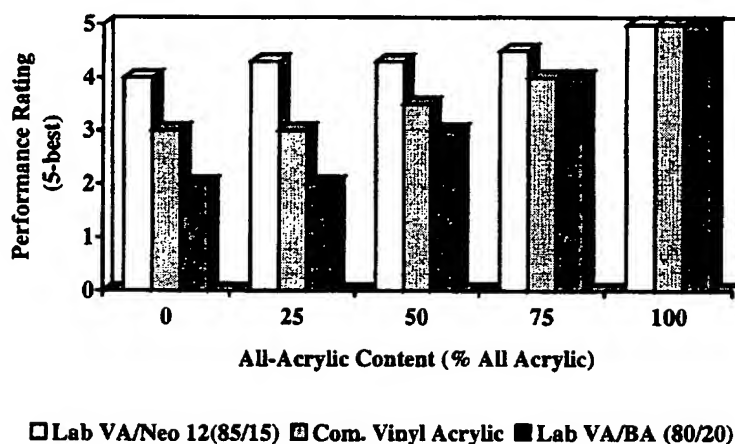


Figure 5 16-month fence test over blockaid

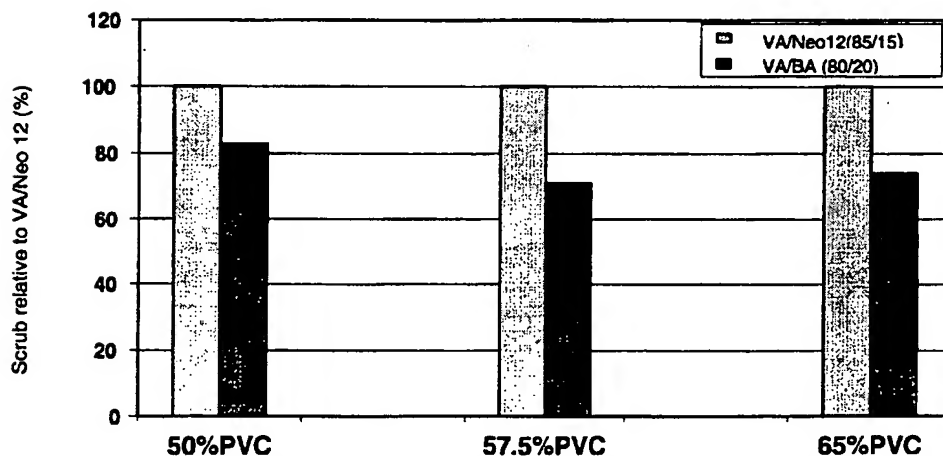


Figure 6 Scrub resistance of VA/BA and VA/Neo 12

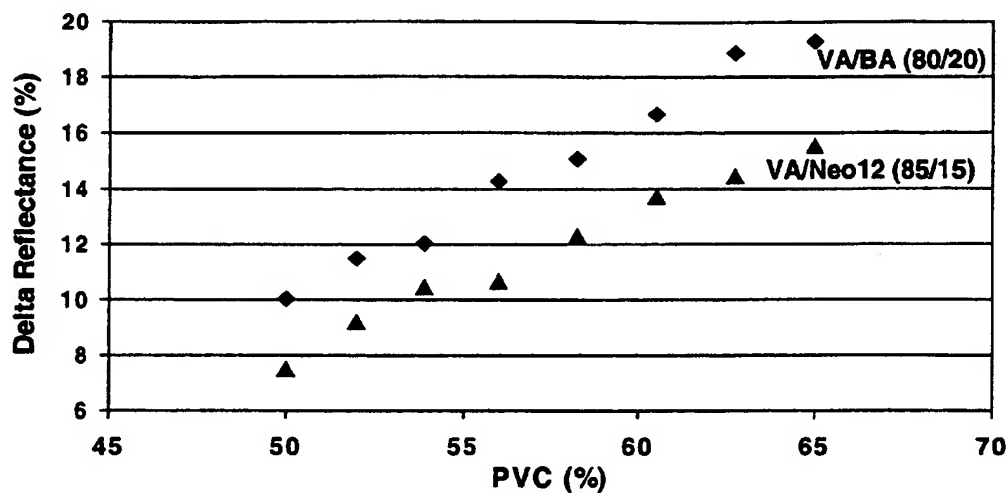


Figure 7 Stain resistance by K&N porosity test

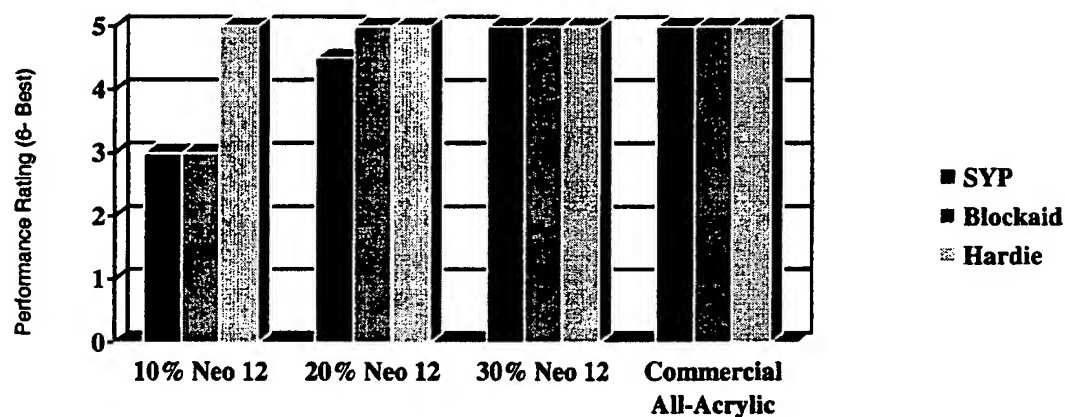


Figure 8 30-month fence test of all-acrylic and VA/BA/Neo 12 terpolymer

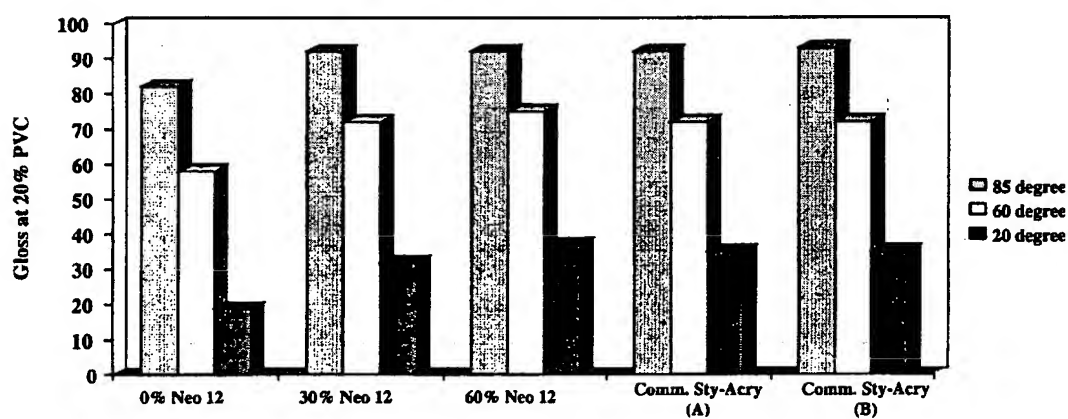


Figure 9 Gloss of formulated paints based on MMA/BA/AA/Neo 12 composition

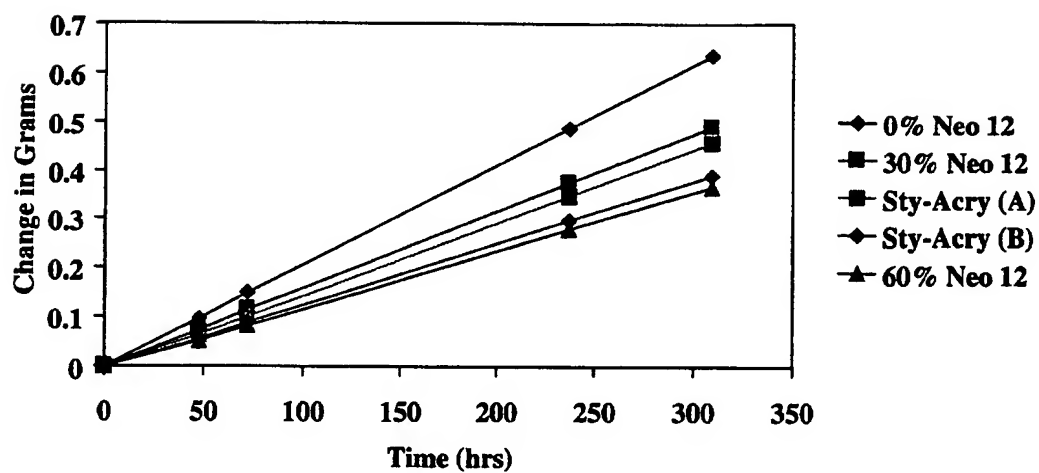


Figure 10 Water vapor transmission of formulated paints for metal coatings

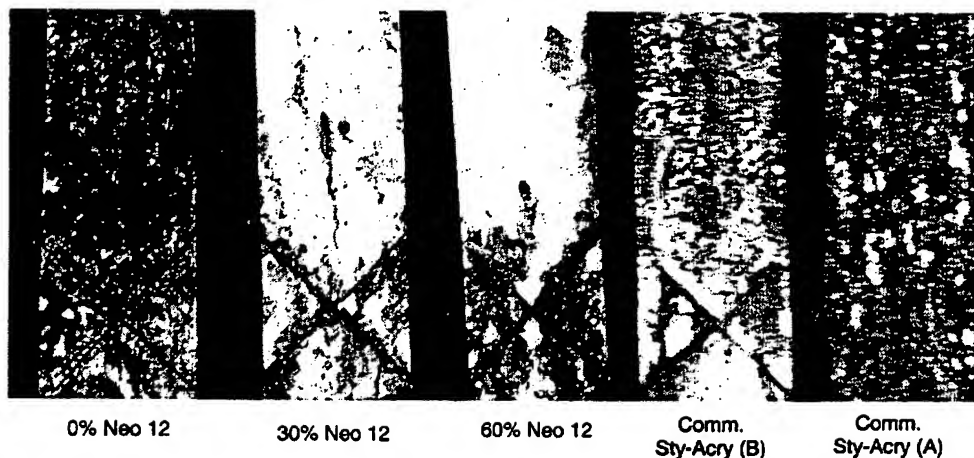


Figure 11 Corrosion test based on 500 hours in salt fog

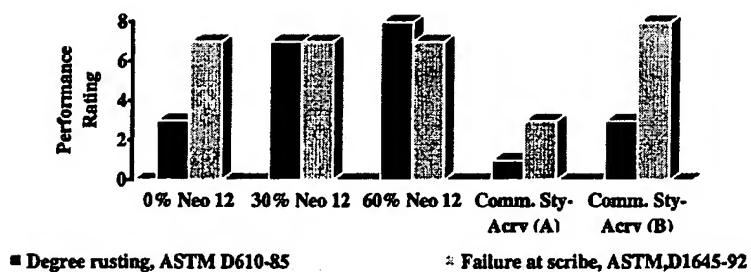


Figure 12 Corrosion resistance of MMA/BA/AA/Neo 12 copolymers versus commercial styrene-acrylics

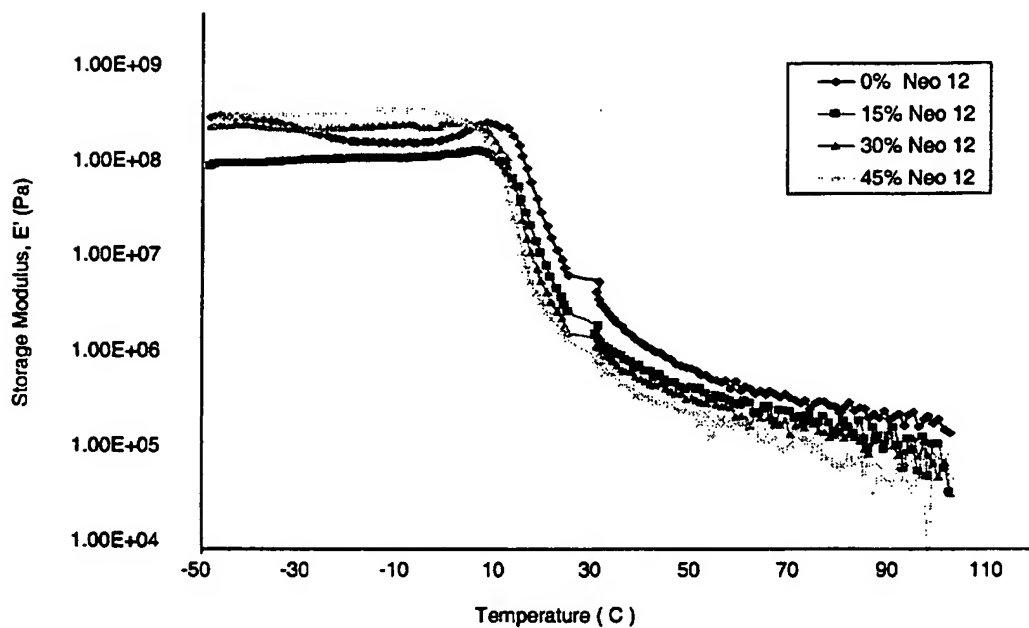


Figure 13 Storage modulus of VA/BA/Neo 12 terpolymers

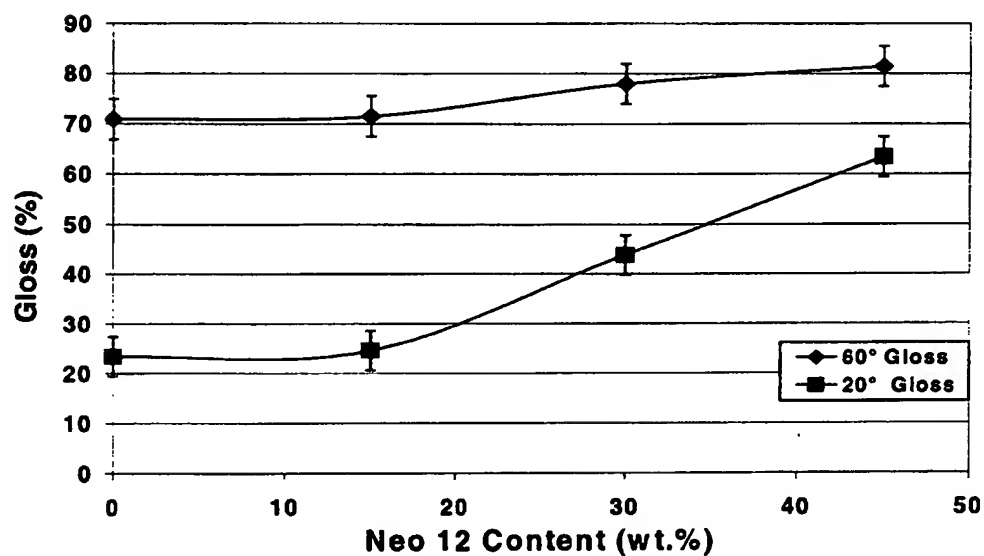


Figure 14 Gloss for VA/BA/Neo 12 films.

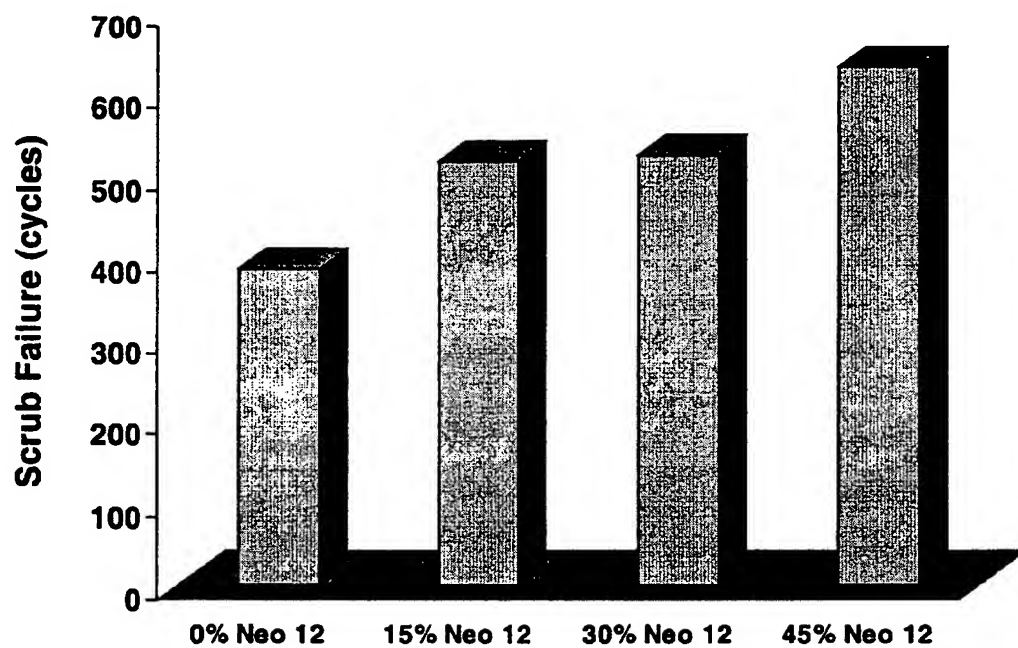


Figure 15 Scrub resistance of interior flat paint containing VA/BA/Neo 12 binder

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